

**AMENDMENTS TO THE SPECIFICATION:**

Please amend the specification as follows:

Page 1, replace the paragraph beginning on line 10 with "US Patent 5, 204,082," with the following amended paragraph:

US Patent 5,204,082 by ~~Schende~~ Schendel (1993) describes a method for preparing high purity SO<sub>2</sub> based on the submerged combustion of elemental sulfur in liquid state, using both air and pure oxygen. This method has the inconvenient of trailing particles of unburned sulfur from the liquid sulfur present both as a reagent and as a solvent. Thus the method uses different unit operations for removing these particles of sulfur trailed from the combustion phase.

Page 2, replace the paragraph beginning on line 1 with "Therefore it is," with the following amended paragraph:

~~Therefor~~ Therefore it is necessary to carefully control the melted sulfur temperature because the variation of its viscosity with the temperature, in order to avoid the difficulties in the liquid sulfur flow being burnt. In other words, this submerged combustion has the characteristic of requiring a good control of liquid sulfur temperature and its subsequent recycling for obtaining high purity without major concern of gaseous by-products produced together with SO<sub>2</sub>.

Page 3, replace the paragraph beginning on line 4 with "JP Patent 26011," with the following amended paragraph:

JP Patent ~~26044~~ 58026011 by Chibooru B. (Bayer AG, 1983) uses the sulfur combustion with oxygen at 1000-1100°C adding sulfuric acid of 20 to 90% concentration, instead of 800 – 1300°C required without adding sulfuric acid. Nevertheless, the purity of the SO<sub>2</sub> produced is not high, specially when for this low

temperature it is required further addition of hydrocarbons as fuel compensating the lower temperature.

Page 3, replace the paragraph beginning on line 9 with "JP Patent 309707," with the following amended paragraph:

JP Patent ~~309707~~ 09-309707 by Araki K. (Mitsubishi Heavy Ind. Ltd., 1997) describes an equipment to produce high purity SO<sub>2</sub>, based on the combustion of solid sulfur with oxygen or with oxygen enriched air. The combustion gases are cooled with H<sub>2</sub>O; the SO<sub>3</sub> is removed with a humid type electric powder collector and a gas separator for removing the unreacted O<sub>2</sub>, CO<sub>2</sub> and N<sub>2</sub>, in its case. Nevertheless, this system requires various purification steps to obtain a high purity SO<sub>2</sub>.

Page 3, replace the paragraph beginning on line 15 with "These patents allow," with the following amended paragraph:

These patents allow one to appreciate that all the described processes require working with the impurities produced in the sulfur oxidation, or combustion, in order to arrive ~~[[to]]~~ at a process offering pure SO<sub>2</sub>.

Page 3, replace the paragraph beginning on line 18 with "Present invention permits," with the following amended paragraph:

The present ~~Present~~ invention permits one to avoid not only the ~~critic~~ critical control of the oxidation temperature itself, but to simplify the unit operations as the combustion with pure oxygen, diluted with SO<sub>2</sub> produced in the system itself as a closed system, makes its advantages clear for any ~~[[skill]]~~ one skilled in the art, the thermically autocontrolled oxidation producing high purity SO<sub>2</sub>. The automation introduced in this

invention allows not only a better control of the process, but also a production of variable capacity.

Page 4, replace the paragraph starting on line 5 with "Figure 2 represents," with the following new paragraph:

Figure 2 represents a detailed description of the electronic circuit of the automated control, wherein each sensor involved is described as follows: liquid sulfur flow sensor, pure oxygen flow sensor, return SO<sub>2</sub> flow sensor, oxygen transmission sensor, sulfur transmission sensor, return oxygen indicator sensor, each sensor or indicator has associated therewith an electronic component and a transmitter, all of these signals being transmitted to a PLC, wherein the control connection function associated with all of the control elements allows to maintain the system operating automatically according to the predefined parameters of the sulfur combustion.

Page 4, replace the paragraph beginning on line 6 with "Figure 3 is," with the following amended paragraph:

Figure 3 is a schematic diagram of the burner showing the admissions and the distribution of the comburent gas, as primary (6), secondary (7) and tertiary (8) gas used for the controlled combustion of the atomized sulfur.

Page 4, replace the paragraph beginning on line 13 with "The SO<sub>2</sub> automated," with the following amended paragraph:

The SO<sub>2</sub> automated production system described in the present invention corresponds to the plant automated control based on oxygen sensors and on oxygen and sulfur flow sensors. Furthermore, this description shows how by varying the

amounts of liquid SO<sub>2</sub> or final product, the flows of oxygen, sulfur and unliquified return SO<sub>2</sub> vary under control.

Page 5, replace the paragraph beginning on line 1 with "The description of," with the following amended paragraph:

The description of the process is made with reference to the general flowsheet shown ~~on figure~~ in Figure 1. The incorporation of sensors for oxygen, for the sulfur flow and for the SO<sub>2</sub> flow is shown ~~on figure~~ in Figure 2 specifically representing these components of the process. The features of the combustion are made by reference to ~~figure~~ Figure 3 representing the structure of the burner with its atomizer for a production capacity not higher than 30 tons per day. For higher productions only the change of the burner and a combustion chamber suitable for said capacity are required. On the other hand, ~~figure~~ Figure 4 represents the liquefaction system of the SO<sub>2</sub> produced by compression as an alternative to the system of liquefaction only by cooling.

Page 5, replace the paragraph starting on line 10 with "Figure 2 represents," with the following new paragraphs:

Figure 2 represents in detail the control diagram of the automated process.

Figure 2 shows the following elements:

- sulfur flow 5.
- FE 05 sulfur flow sensor.
- FIT 05 transmission sensor indicator of sulfur flow.
- FV 05 sulfur flow valve.
- FY 05 electronic component FV 05 valve for sulfur.
- FIC 05 control connection function (PLC software) for the control of sulfur flow.
- oxygen flow 9.

- AE 17A oxygen sensor.
- FIT 09 transmission sensor indicator of oxygen flow.
- FV 09 proportional control valve for oxygen flow.
- FY 09 electronic component FV 09 valve for oxygen.
- FIT 17B transmission sensor indicator of return SO<sub>2</sub> flow.
- FQI 17 (B) control connection function (PLC software) return SO<sub>2</sub> flow.
- AIT 17A transmission sensor indicator of return oxygen.
- FQI 09 (m) control connection function (PLC software) for the control of oxygen flow between oxygen in SO<sub>2</sub> return and pure oxygen.
- FQI 09 control connection function (PLC software) for the control of pure oxygen flow.
- FFIC 09 control connection function (PLC software) for the control of oxygen flow.
- M : flow meter.
- SP: set point.
- AS: pneumatic signal (dry air) by means of the valves FV 05 y FV 09 are operated.
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Page 5, replace the paragraph beginning on line 14 with "Thus, according to," with the following amended paragraph:

Thus, according to the details of figures Figures 1 to 4, a 170 kg/h flow of sulfur in solid or liquid state is entered into the storage tank (1) and then maintained at a temperature of 125 - 130°C with the steam produced following the combustion chamber (4) in ~~[[the]]~~ a multistep heat multistep exchanger (10) of this process. This sulfur enters into the feed ~~[[tank]]~~ sulfur (2) maintained at a temperature from 130 to 135°C with the same steam produced after the combustion of the sulfur in the multistep heat exchanger (10); this steam is the same that, after transferring part of its heat to the feed ~~[[tank]]~~ sulfur (2) is carried to the storage tank (1). These two steps have the purpose of

maintaining the sulfur in liquid state for its handling and for removing the impurities proper of the delivery, in particular the most heavy ones, and the moisture.

Page 6, replace the paragraph beginning on line 1 with "The feed sulfur," with the following amended paragraph:

The feed sulfur is maintained liquid in the range of 130 – 135°C in the feed ~~[[tank]]~~ sulfur (2) and therefrom is fed to the ~~atomizer~~ burner (3), represented in detail in ~~figure~~ Figure 3, with a standard fluid pump through the sulfur entrance (5), as at this temperature it offers no problem of viscosity. In this temperature range, the viscosity is lower than 10 mPa/s. As an antecedent, the sulfur under 160°C rapidly increases its viscosity to reach values of 80,000 mPa/s at 190°C. The liquid sulfur is introduced in the burner (3) being part of the combustion chamber (4).

Page 6, replace the paragraph beginning on line 12 with "The liquid sulfur," with the following amended paragraph:

The liquid containing sulfur is ~~entered~~ put up with the sulfur entrance (5) through the central back part of the burner (3) and through another also back entrance ~~[[ (06) ]]~~, parallel to the sulfur entrance (5), the O<sub>2</sub> enriched return SO<sub>2</sub> called "primary gas" (6) is entered (Figure 3). The primary gas is the one introduced in wrapping form with the liquid sulfur which is then pulverized by effect of the high speed of the mobile cup of the atomizer in the burner producing microdrops. This mixture of SO<sub>2</sub>, oxygen and finely pulverized sulfur in microdrops leaves the rotatory cup of the atomizer and enters ~~enter~~ into the combustion chamber (4) where the sulfur oxidative combustion step occurs transforming the sulfur ~~[[in]]~~ into pure SO<sub>2</sub> by the action of oxygen being part of the combustion gas and called tertiary gas (8).

Page 7, replace the paragraph beginning on line 3 with “This temperature control,” with the following amended paragraph:

This temperature control in the combustion chamber ~~[[inner]]~~ (4) is reached by a suitable handling of the SO<sub>2</sub> return gases (17) by means of the automation based on the return oxygen; therewith a temperature above 1144°C ± 50°C and lower ~~[[to]]~~ than 1231°C is reached. In said conditions, the process is easily controlled resulting in a high purity SO<sub>2</sub>.

Page 7, replace the paragraph beginning on line 8 with “The combustion gases,” with the following amended paragraph:

The combustion gases at the temperature of 1167 ± 50°C are following passed through a ~~heat multistep~~ multistep heat exchange (10) with water ~~[[ (10) ]]~~ shown in ~~figure~~ Figure 1, and steam is produced at a temperature range of 145 – 160°C mainly used for maintaining in liquid state the feed sulfur (2) entering into the burner (3) and the storage ~~[[one]]~~ tank (1). The steam excess produced can be used for other heat exchange unit operations in an industrial chemical plant.

Page 7, replace the paragraph beginning on line 17 with “The gases pass,” with the following amended paragraph:

The gases pass then into a tower (12) removing SO<sub>3</sub> and the moisture that eventually could enter into the system through tank (13), with concentrated 98% H<sub>2</sub>SO<sub>4</sub> ~~[[ (13) ]]~~ at 30°C. This tower is provided with a sulfuric acid drop trap (14) so as the gases passing therein essentially comprise SO<sub>2</sub> and O<sub>2</sub> unreacted in the combustion chamber.

Page 8, replace the paragraph beginning on line 4 with "From the total," with the following amended paragraph:

From the total mass moved by the blower (18) up to a 30% is circulated to the cooling plant ~~[[ (15) ]]~~ (15A) by means of the blower (19). This cooling plant works at a temperature from -30 to -60°C. From this gas fraction, a high part is liquefied and comprises the SO<sub>2</sub> as final product (16) and the other cooled part comprises essentially SO<sub>2</sub> and O<sub>2</sub>; both gases re-enter into the system through the blower (20). This return SO<sub>2</sub> (17) comprising about the 80% of the total SO<sub>2</sub> flow is driven to the combustion chamber (4) but, before entering therein it is mixed with the pure oxygen (9) in order to form the comburent mixture entering into the combustion burner.

Page 8, replace the paragraph beginning on line 14 with "As an alternative," with the following amended paragraph:

As an alternative to the aforementioned process of SO<sub>2</sub> liquefaction by cooling, the also efficient way of liquefaction by means of a compressor working between ~~[[3,8]]~~ 3,8 and ~~[[5,0]]~~ 5.0 bar of pressure together with cooling by water allowing an easy controlled liquefaction can be used. This is shown in ~~figure~~ Figure 4 wherein it can be appreciated an automated SO<sub>2</sub> production plant producing liquid SO<sub>2</sub> by compression with its compression unit ~~[[ (15) ]]~~ (15B) and the lung tank (21). The non compressed gases return to the recycling system through the lung tank, therefrom a blower (20) integrates it to the rest of the SO<sub>2</sub> returning to the combustion chamber (4).

Page 10, replace the paragraph beginning on line 3 with "The flows involved," with the following amended paragraph:

The flows involved in the control, represented ~~on figure~~ in Figure 2, are:



F05: S flow.

F09: O<sub>2</sub> flow.

F17: cooling/diluent flow.

Page 10, replace the paragraph beginning on line 7 with "For measuring the," with the following amended paragraph:

For measuring the S flow~~[[, F 05]]~~ (F 05), a sonic type flow sensor (FE/FIT-05) is used. The O<sub>2</sub> flow, F09, is measured in the same manner and the flow of the returned SO<sub>2</sub> F17 is measured with FIT-09) and ~~FIT-17)~~ FIT-17B) rotamers, respectively. The sulfur flow is adjusted by the proportional valve ~~[[FV.05]]~~ FV-05 and the O<sub>2</sub> is controlled ~~[[wit]]~~ with a proportional valve ~~[[FV-07]]~~ FV-09. The content or concentration of O<sub>2</sub> in the F17 flow is measured by a O<sub>2</sub> sensor ~~(AE/AIT-17)~~ (AE/AIT-17A).

Page 10, replace the paragraph beginning on line 12 with "The first control," with the following amended paragraph:

The first control connection consists in the regulation of the S flow (F 05) to the burner by ~~[[the]]~~ a sulfur flow meter ~~[[05]]~~ and the proportional control valve FV-05.

Page 10, replace the paragraph beginning on line 14 with "The second control," with the following amended paragraph:

The second connection control consists in the regulation of the O<sub>2</sub> flow by ~~[[the]]~~ a flow meter ~~[[09]]~~ and the proportional control valve FV-09. The adjustment of the flow is carried out such as to maintain constant the S:O<sub>2(total)</sub> ratio. The total O<sub>2</sub> is obtained from the addition of pure O<sub>2</sub> plus the return O<sub>2</sub>, the latter being calculated by the flow sensor 17B and the O<sub>2</sub> analyzer 17A.

Page 12, replace the paragraph beginning on line 6 with "The above description," with the following amended paragraph:

The above description with the features of the oxidation process itself without gases generating byproducts, such as nitrogen, ~~[[ang]]~~ and only with pure oxygen diluted with SO<sub>2</sub> produced in the closed circuit system; the SO<sub>2</sub> high purity controlled by analysis before and after the combustion; its stepping for different production capacities; the different routes for obtaining liquid SO<sub>2</sub> either by cooling or compression; as well as the oxidation process computer simulation indicate for any skill in this area of processes that the system offers significant advantages relating to the state of the technique not automated and not working under closed circuit such as the one described in present patent application.